animals of the chase; food-fishes; whales; pearl-**mussels.**

Group B.—Animals *bred* or *cultivated* by man for food or for the use of their products in industry or for their services as living things. *Examples:*—flocks and herds; horses; dogs; poultry; gold-fish; bees; silkworms and leeches.

Group C.—Animals which directly promote man's operations as a civilised being without being killed, captured or trained by him. *Examples:*—scavengers such as vultures; carrion-feeding insects; earthworms and flower-fertilising insects.

Group D.—Animals which concern man as causing bodily injury, sometimes death, to him, and in other cases disease, often of a deadly character. *Examples:*—lions; wolves; snakes; stinging and parasitic insects; disease-germ carriers, as flies and mosquitoes; parasitic worms; parasitic Protozoa.

Group E.—Animals which concern man as causing bodily injury or disease (both possibly of a deadly character) to (*a*) his stock of domesticated animals; or (*b*) to his vegetable plantations; or (*c*) to wild animals in the preservation of which he is interested; or (*d*) to wild plants in the preservation of which he is interested. *Examples:*—Similar to those of Group D, but also insects and worms which destroy crops, fruit and forest trees, and pests such as frugivorous birds, rabbits and voles.

Group F.—Animals which concern man as being destructive to his worked up products of art and industry, such as (*a*) his various works, buildings, larger constructions and habitations; (*b*) furniture, books, drapery and clothing; (*c*) his food and his stores. *Examples:*—White ants; wood-eating larvæ; clothes' moths, weevils, acari and marine borers.

Group G.—Animals which are known as " beneficials " on account of their being destructive to or checking the increase of the injurious animals classed under Groups D, E, and F. *Examples:*—Certain carnivorous and insectivorous birds, reptiles and Amphibia; parasitic and predaceous insects, acari, myriapods, &c.

We have, then, in this " First Report on Economic Zoology " a large number of expert discussions of particular points—all of practical importance and some of theoretical interest as well; and we have also a luminous orientation of the whole subject. No one can help being impressed by the fact that zoology does not lose either in interest or in thoroughness as it becomes more social.   J. A. T.

IRRIGATION WORKS.

Irrigation Engineering. By Herbert M. Wilson, C.E. Fourth edition. Pp. xxiii + 573. (New York : John Wiley and Sons; London : Chapman and Hall, Ltd., 1903.) Price 17s. net.

AN annual grant of about 500,000l. having been recently allotted by the Congress of the United States for the construction of irrigation works in arid regions, under the supervision of the director of the Geological Survey, various projects have been prepared

with a view to their execution in the near future; which have already given employment to a number of engineers. This development has enhanced the importance of a sound knowledge of the principles of irrigation engineering, and has, accordingly, led the author to revise thoroughly and enlarge his oook on the subject.

The area of land irrigated in the United States, reaching more than $7\frac{1}{2}$ million acres, is second only to India with 33 million acres, being larger than the irrigated area in Egypt of 6 million acres, in Italy of $4\frac{7}{10}$ million acres, and in Spain of $2\frac{4}{5}$ million acres. The States in which irrigation has been most resorted to are Colorado, California, Montana, Utah, and Idaho, with irrigated lands ranging from $1\frac{1}{3}$ million to half a million acres. After a very short introductory chapter on irrigation, the book is divided into three parts, dealing with hydrography, irrigation canals and canal works, and storage reservoirs respectively, in nineteen chapters altogether.

The subjects treated of in the first and third parts are, for the most part, similar to those contained in books on water-supply, the chief exceptions being chapter iv., on alkali, drainage, and sedimentation; chapter v., on the quantity of water required; and the end portion of the last chapter in part i., relating to sewage irrigation, which belongs strictly to sewage disposal. When the drainage of irrigated lands is not efficiently provided for, and an excess of water is carelessly distributed, any alkali in solution in the water accumulates by the evaporation which occurs as soon as the water rises to the surface, sodium carbonate being the most injurious to the soil; and the land also becomes water-logged and swampy, which, besides being bad for agriculture, is liable to occasion malarial fevers. Silt, which is brought down in large quantities in flood-time by many rivers, the waters of which are used for irrigation, is very valuable as a manure if it can be spread over the land, but it is very liable to deposit in the storage reservoirs and canals provided for irrigation, before the water reaches its destination; and the aim of the engineer is to convey the lighter and more fertile silt on to the land with the water, and to arrest the heavier silt before it reaches the reservoir, or to scour it out through sluices in the dam; and in the case of a diversion canal from a river, to arrange its entrance so as to keep out most of the heavier silt, and to make the remainder deposit in a part of the canal from whence it can be readily removed. The amount of water required to irrigate a given area depends upon the conditions of the locality and the crops raised, and forms the basis of all irrigation schemes.

The second part deals with works relating exclusively to irrigation in seven chapters, in which inundation and perennial canals, their alignment, slope, and cross section, headworks and diversion weirs, scouring sluices, regulators and escapes, falls and drainage works, distributaries and the application of water and pipe irrigation, are successively considered; and this constitutes the most important part of the book as regards irrigation. The book, however, as a whole, deals with the principles and practice of irrigation in a very complete manner, and is profusely illus-

trated by forty-one full-page views and plans, and one hundred and forty-two figures in the text; it is written in a simple style and printed in large type; and within a moderate compass the volume furnishes a large amount of information, combined with the results of experience, especially in the United States, which should prove of considerable value to engineers engaged in irrigating arid regions.

OUR BOOK SHELF.

Graphic Statics, with Applications to Trusses, Beams, and Arches. By Jerome Sondericker, B.S., C.E. Pp. viii + 137. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1903.) Price 8s. 6d. net.

THIS is a very practical treatise on the determination of the forces in braced structures, beams, masonry arches, and abutments. It is based on a course of instruction given at the Massachusetts Institute of Technology. The author presupposes a knowledge of the strengths of materials, of the principles of statics, and of ordinary beam formula for stresses and deflections, and is thus able to present his methods in a very concise form without any lengthy preliminary explanation, and he pays special attention to the precautions which should be taken in drawing the diagrams in order to secure the best results.

The graphical processes are accompanied by analytical calculations, and the student is wisely encouraged to make himself familiar with both methods of computation, and not to follow either slavishly. Building construction is mainly drawn upon in providing examples, which include such cases as steel framed buildings under the action of gravitation loads and wind pressures. The author does not employ the strain energy method or its equivalent for structures with redundant elements, but proceeds by arbitrary assumption as to what seems probable in each particular case. This is often the only feasible plan, but too much reliance should not be placed on the results obtained. For instance, there is probably considerable error on p. 79 in the tacit assumption that the reactions in the trussed beam are the same as if the middle support did not yield. Considerable attention is given to frames where the members are subject to binding stresses as well as to direct stresses.

The three-hinged arch is dealt with, and some of the methods which have been proposed for determining the line of resistance in a masonry arch are briefly discussed; the author works out one example in full detail, showing how to find the linear arch which lies within a specified region (such as the middle third), and has the least horizontal thrust.

Memories of the Months. Third series. By Sir Herbert Maxwell, Bart. Pp. xi + 290; illustrated. (London: Edward Arnold, 1903.) Price 7s. 6d.

THE author has no occasion to offer apologies for converting the "Memories" into a trilogy, and it is with sincere pleasure that we welcome this latest addition to a charming series, of which we hope we have not yet seen the end. Whether his subject be forestry, the habits and activity of squirrels, local place-names, salmon-disease, or "vole-plagues," Sir Herbert writes with a charm peculiarly his own, and, while imparting information, does so in a style which many of our best novelists might envy. Perhaps the highest praise we can bestow is to say that whenever one of the author's books comes into our hands for review, we invariably read it from beginning to end—and that with pleasure and satisfaction.

As Sir Herbert is not, we believe, a professed naturalist, a few slight errors, mainly due to lack of acquaintance with current zoological literature, could scarcely fail to occur in a work of this nature. For instance, his arguments and conclusions drawn from the remarkable distribution of the fresh-water fishes of the genus Galaxias (p. 50) are rendered practically nugatory by the recent discovery of a marine representative of that group. Again, he does not appear to be aware that the Thessalian vole (p. 39) has been assigned to a new species by Captain Barrett-Hamilton, under the name of *Microtus hartingi*. We may also direct attention to the practical repetition, on pp. 46 and 47, of the account of the damage inflicted on Scottish pine forests by crossbills given on pp. 1 and 2, the repetition extending even to the fading of the crimson of the head and neck of the bird to dull greenish-olive after death. Another repetition will be found by comparing pp. 73 and 115, in connection with the origin of the name Winchester; with the discrepancy that "Gwent" is stated to mean "white" in the latter, and "downs" in the former passage. Finally, the misprint *Odicnemus* on p. 102 is scarcely consonant with the author's predilection for etymology.

Where all is interesting, it is difficult to select passages for special notice. Attention may, however, be directed to the calculation of the muscular activity of the goldcrest as contrasted with that of man (p. 40). It may also be noted that the author defends his contention as to the limited height to which holly is prickly by the remark that when this has been called in question it is owing to artificial strains, and not the natural wild stock, having been the subject of observations.

With this we must take leave of a volume as charming and full of interest as its predecessors.   R. L.

Educational Woodwork. By A. C. Horth. Pp. 159. (London: Percival Marshall and Co., n.d.) Price 3s. 6d. net.

THE author has attempted to provide, within the restricted limits of a hundred and sixty pages, a three years' course of woodwork, drawing, and object lessons; chapters on discipline, organisation and method; particulars as to the fittings and furniture required for the exercises, as well as hints on the instruction of deaf, blind, and special children. At the same time he has found space for nearly two hundred illustrations. The consequence is that the instructions are meagre, and in many cases quite inadequate. The illustrations in the earlier pages are good, but some of the drawings intended to help the object lessons outlined in chapter viii. will fail to convey much meaning to pupils. The courses of woodwork are also published separately in pamphlet form at fourpence net for each year.

Die Proportion des goldnen Schnitts. By J. Kübler. Pp. 36. (Leipzig: B. G. Teubner, 1903.)

THIS is an attempt to discuss the properties of quantities in continued proportion, and in particular the series of proportionals derived from the problem of medial section, in connection with a large number of mathematical, physical, and even physiological problems.

If books of this kind are written and read as a recreation by people who enjoy thinking about semi-mathematical and semi-philosophical considerations, and who merely take the conclusions arrived at for what they are worth, without attaching special scientific value to them, then the present volume completely fulfils its object.